Power Battery Company, Inc. Field Service Manual

Valve Regulated Lead Acid (VRLA) Battery

Field Service and Application Manual

First Edition
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Scope

This manual has been designed to provide the user with some specific battery application and field service information. It has been divided into nine sections by subject matter for ease of use. By following these guidelines one can expect safe, reliable, cost-effective service from Power Battery V.R.L.A. batteries.

Power Battery believes that with qualified experienced personnel, following these instructions step-by-step, adopting normal safety precautions for electrical installations, paying particular attention to those emphasized in the attached specification and with the safety features built into the cabinets there should be no reason for personnel to be exposed to undue electrical hazards.

This information is presented in good faith, but no additional warranty is expressed or implied. In as much as any assistance furnished by Power Battery Company. Inc. with reference to the proper use of its products without charge, power Battery Company, Inc. assumes no obligation or liability therefore.

SAFETY

General Safety Rules for Handling Power Battery Company, Inc. Batteries

DO use qualified personnel only for battery handling and maintenance.

DO follow all Power Battery and charger maintenance instructions.

DO wear protective equipment (face shield, goggles, gloves) when working with or around battery systems.

DO make sure that all charging/discharging circuitry is completely disconnected from the battery system before making or breaking any connections.

DO check with Power Battery before making any design changes to the battery system.

DO use proper lifting techniques when working with the batteries.

DO NOT lift any battery by the battery terminals.

DO NOT allow tools or unconnected cables to rest on top of the batteries or touch the battery terminals.

DO NOT use power tools that can develop more torque than the torque specified for connections.

DO NOT use any chemical cleaners to clean the batteries.

DO NOT remove vent caps or add anything to the batteries.

DO NOT smoke or carry open flames near any battery or system.

DO NOT approach any energized battery system that shows signs of severe over charging or over discharging (severe swelling, cover deformation, vent caps missing). Disconnect and isolate the battery system from all charging and discharging circuitry before approaching the system.

DO NOT circumvent any device installed by Power Battery or the Charger Manufacturer for the purpose of protecting the battery system. These devices include: Fuses and Circuit Breakers, Disconnects, Switches and any other protection devices.

Storage Requirements

Storage

All lead-acid batteries will self-discharge when allowed to stand on open circuit. This self-discharge is due to "Local Action" caused by dissimilar metals (positive vs. negative plates) used within the cell's construction. The result of the self-discharge is loss of cell open circuit voltage, consequently loss of capacity. If allowed to progress beyond the normal limits, excessive plate sulfation may occur causing permanent loss of capacity and premature battery failure.

These batteries have been designed to minimize the effects with the use of the purest plate materials available. This has resulted in a reduction of the self-discharge rate to approximately one-fifth of a conventional lead acid battery. The rate of self-discharge will also be dependent upon the battery's storage temperature. Lower storage temperatures will reduce the self-discharge rate; higher temperatures will increase the rate. A cool, dry area is the recommended environment in which batteries should be stored. They should also be placed away from any heat sources including heaters, steam pipes, equipment or in direct sunlight. The table below represents the maximum allowable storage time at various battery storage temperatures.

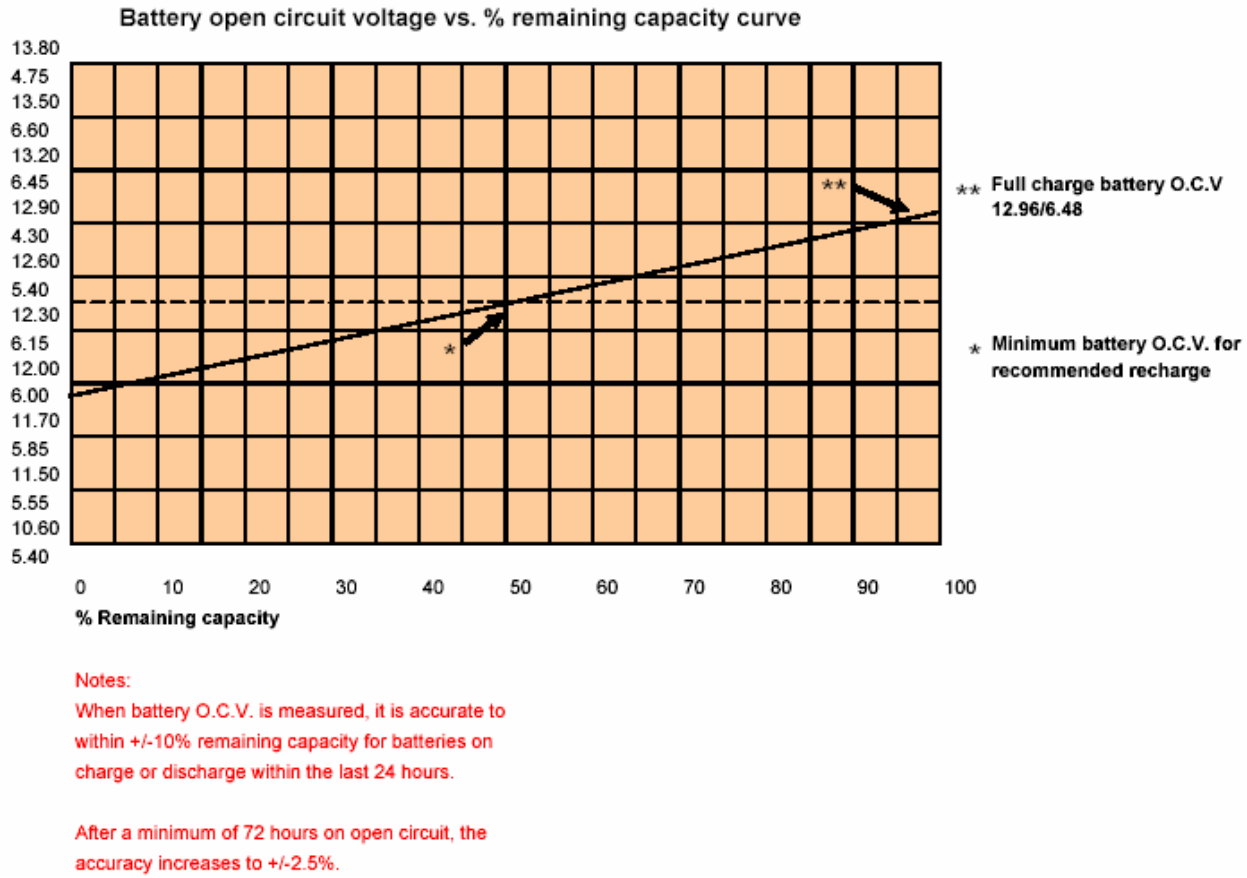
Storage parameters

Ambient Temperatures	Typical storage time
0°F - 32°F	12 months
33°F - 65°F	9 months
66°F - 90°F	6 months
91°F - 105°F	3 months
106°F - 120°F	1 1/2 months

Battery Open Circuit Voltage:

A useful tool in determining the battery's state of charge while in storage is the open circuit voltage (O.C.V.). The O.C.V. is a relative measure of the electrolyte concentration (specific gravity) contained within the battery. The electrolyte specific gravity is a direct measure of the battery's state of charge and can be used to determine the percentage of battery capacity remaining at any given point. This relationship is exhibited on the "Battery Open Circuit Voltage vs. Percent Remaining Capacity" curve (DWG# BSD- OCV). From this curve it can be seen that a battery voltage of 1.98 V.P.C. (11.88 for 12 volts, 5.94 for 6 volts) or less will have zero percent capacity remaining. In order to prevent any possible permanent plate damage from occurring due to self-discharge, it is recommended that when any battery in storage has an O.C.V. corresponding to the 50% capacity level (12.40 for 12 volts, 6.20 for 6 volts), it should be promptly recharged.

DWG. # BSD- OCV



Notes

Using these parameters, one can take advantage of the longest possible storage durations without subjecting the battery to any potential harm caused by the delirious effects of prolonged self- discharge. The open circuit voltage (O.C.V.) can also be useful in approximating the remaining storage time available before the batteries reach the minimum O.C.V. (12.40V / 12V or 6.20V / 6V) before recharge. A curve has been provided to show the relationship of "Battery O.C.V. vs. Percent Storage Time Remaining" (DWG. # BSD- OCV). To use this curve take the O.C.V. of the battery and locate the point on the curve which intersects with the percent remaining storage time. This percentage is then multiplied by the storage time and temperature parameters given earlier to calculate the approximate storage time remaining before required recharge. It should be noted that the battery's O.C.V has some limitations on its accuracy. The percent capacity remaining is within -10% or +10% if the battery has been on charge or discharge within the last 24 hours. After a battery has remained on open circuit for a minimum of 72 hours the accuracy increases to -2.5% or +2.5%

The battery O.C.V. can also be used in approximating the state of charge after a discharge using the same parameters as described above. However, it should be noted that this does not apply for the percentage of remaining storage time curve as all batteries should be recharged immediately after a discharge. All batteries should be recharged using a constant voltage of 2.27 - 2.30 V.P.C., at 77°F, for a minimum of 24 hours or until the float current stabilizes for 3 consecutive hourly readings. Battery carton date coding All battery cartons are date coded with a recommended recharge data. The date code (month / year) has been calculated for "normal" storage temperature conditions (66°F - 90°F) and dated 6 months from the battery's last full charge. The battery's O.C.V. should continue to be checked at frequencies described earlier to give a true indication of when a battery will require a recharge. Battery terminal date coding consists of the month and year date of manufacture located on the negative battery terminal unless noted otherwise.

Due to the natural self-discharge of the batteries, many of the storage parameters discussed earlier would apply when "shutting down" and storing a battery system. As before, the battery's O.C.V. is a useful tool in determining when a recharge would be required. All batteries placed in storage should be fully charged before shutting down and disconnecting from the system.

The batteries may also need to be relocated if the environment is not suitable for storage (refer to storage parameters). When shutting down a battery system that has been in use, some additional considerations will need to be made. First, and foremost, the batteries must be fully charged before the equipment is shutdown. Second, the battery must be disconnected (via disconnected, breaker, etc.) completely from the equipment circuitry. One must insure that all possible loads are also disconnected so that the batteries are not unknowingly discharging during the shutdown period. Examples of other small loads may be shunted devices or other small resistive loads tied into the circuit. As an additional safety measure one of the battery fuses or intercell connections can be removed.

Caution: Be sure battery system is disconnected from circuit before removal of any intercell connectors.

Finally, record the date when the system was shut down and include this with the regularly scheduled maintenance records for future use. It may also be advisable to place a recharge date directly on the batteries as an additional visual aid to indicate when a recharge would be required.

Ventilation

4.0

Ventilation

When Power Battery series of batteries are charged at constant potentials below 2.37 VPC at temperatures up to 92ºF, (33.33ºC) and below 2.25 VPC up to 107ºF, (41.67ºC) 100% of the gases produced are recombined internally so that no gas is evolved. If the batteries are charged at higher voltages or temperatures, small amounts of gas may be evolved. Recombination efficiency is about 90% at 2.5 VPC @ 107ºF (41.67ºC).

Power Battery VRLA batteries internally recombine all gasses generated within the batteries if they are charged or maintained on float within the recommended charge conditions. If the batteries are charged at voltages above 2.37 VPC (14.22 volts for 12 volt batteries) small amounts of gas may be evolved, particularly if the batteries are above ordinary temperature.

A typical UPS battery installation uses battery cabinets with an internal volume of 56 cubic feet (Power CR4). Such cabinets usually contain 40 batteries occupying 23 cubic feet and electronic gear occupying 1 cubic foot leaving 32 cubic feet of free air space. The cabinet has ventilations slots with a total open area of 0.32 square feet. Hydrogen will leave the cabinet both by diffusion through the ventilation slots (and other openings) and by convection.

Calculations based on the known diffusivity of hydrogen show that a maximum equilibrium concentration of 0.062% hydrogen will be reached within the CR4 cabinet when the batteries are charged at 2.5 VPC at 77ºF (25ºC) without any convection.

If the batteries are charged under the extreme condition of 2.5 VPC at 107ºF (41.67ºC) about 80ml per hour will escape from each battery so that diffusion alone will result from each battery so that diffusion alone will result in a maximum cabinet concentration of 0.23% hydrogen. Since some convection will occur, the actual hydrogen concentrations will be well below these calculated equilibrium concentrations.

The calculation of Gas Produced and Recombination Efficiency is not strictly correct since some small current will be accepted by all batteries without the production of gas.

The error is very small and, since the calculation provides a convenient way to compare recombinant batteries of different design, many battery researchers have used the method.

The data shown in the table has been plotted on the attached charts that show Gas Recombination Efficiency and Actual Gas Evolution as a function of Cell Voltage.

The minimum concentration of hydrogen in air that is required for combustion is 4.1%. The current IEEE standard for the maximum safe concentration of hydrogen in air is 2%. The maximum, diffusion limited, equilibrium concentration of 0.23% obtained at 2.5 VPC and 107ºF (41.67ºC) is about 10% of this.

If charging is done under the more normal conditions of 2.37 VPC hydrogen concentration within the cabinet will not exceed 0.02% and will approach the natural atmospheric hydrogen concentration of 0.01%.

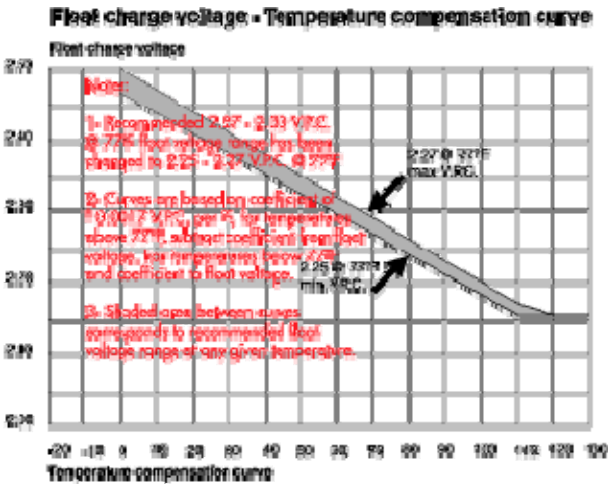
If Power Battery VRLA batteries are operated within the recommended guidelines and if cabinet ventilation slots are not impeded, there is no possibility of reaching dangerous concentrations of hydrogen within the battery cabinet.

Temperature

5.0

Temperature

Heat is the worst enemy of any battery. Its effects must be seriously taken into account and steps must be taken to minimize these effects. The application parameters to do so are covered below.



Battery system location is the first part of the application detail needed to properly size and use any battery. It is recommended that a battery system's average temperature be maintained between 68° (77°F). A cell-to-cell variation of 5°F (maximum) is also highly desirable. When a system location calls for temperatures outside these parameters, applications engineering may use one of the following methods. Design the system with the added temperature environment controls (ex: change o system location, forced air circulation and/or cooling pro-visions, etc.) or use the temperature compensation float voltage coefficient of + 0.0017 V.P.C. or -0.0017 V.P.C. per °F. For temperatures above 77°F subtract coefficient from float voltage. For temperatures below 77°F, add coefficient to float voltage.

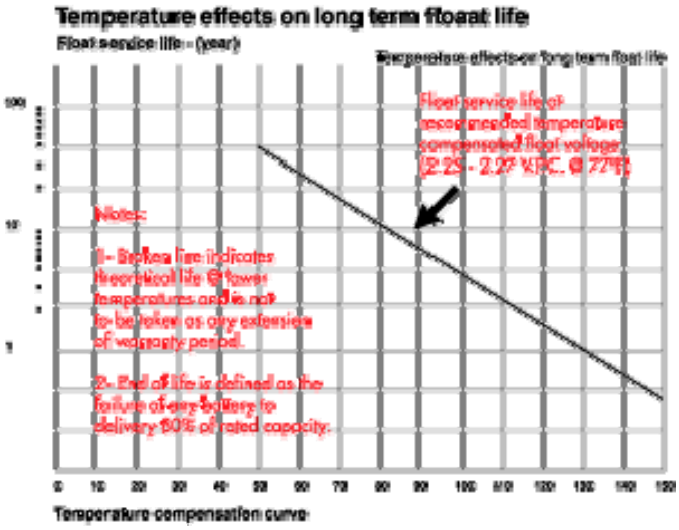
A battery system's discharge capacity:

A battery system's discharge capacity is directly related to the battery's temperature. PRC Series batteries are rated 100% at 77°F. The percentage of capacity available at a specific rate of discharge can be taken directly from the "Percent Capacity VS. Temperature" curve (DWG# BTD-377) enclosed. To use, one must first select the rate of discharge closest to the actual rate the application calls for, then travel along the curve to the expected operating temperature on the horizontal axis. Now, find the point on the vertical axis that corresponds to the temperature and rate curve selected. Multiply this percent capacity by the ampere or wattage rate on the published discharge curves to arrive at the temperature corrected discharge rate.

The designed float service life:

The designed float service life of Power Battery batteries is 10 years at 77°F using a 2.27 - 2.30 V.P.C temperature compensated float charge voltage. The float service life is directly related to the application's operating temperature. For temperatures above 77°F standard, grid growth (corrosion) is accelerated and battery life is shortened. The actual amount in which the life will be affected is given on the "Temperature effects on long term float life" curve (DWG# BTD-277) enclosed. This curve was derived from experimentation based on the developments by the scientist E. Willihnganz in a paper presented in "Electrochemical Technology", Oct, 1968. This paper titled "Accelerated Life Testing of Stationary Batteries" describes the test procedures performed to obtain the experimental data on battery float service life. This procedure is the most widely accepted method of accelerated testing used today because the primary cause of battery failure, grid growth (corrosion), has been found to correspond with the failure mechanisms found in actual field tests.

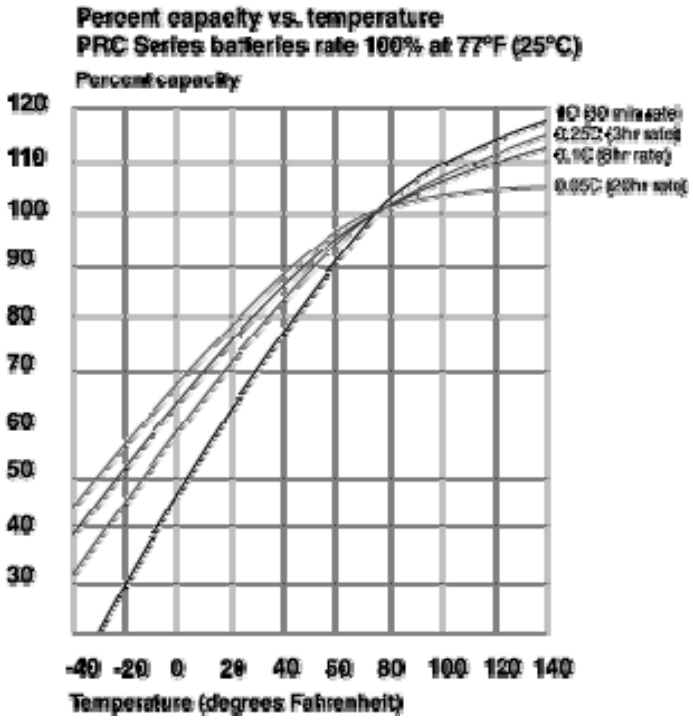
One final note with regards to the use of valve regulated lead acid batteries is that most immobilized electrolyte systems are less forgiving than the traditional flooded battery systems. These designs are such that many application advantages are inherent but careful attention must be paid to all the parameters of the application's environment. As discussed, with proper maintenance and monitoring of these parameters, the batteries will perform and provide the level of service in which they're designed.


Temperature effects on long term floaat life
Float service life - (year)
Temperature effects on long term float life
Float service life at recommended temperature compensated float voltage (2.25 - 2.27 V.P.C. @ 77F)
Notes:
1- Broken line indicates theoretical life @ lower temperatures and is not to be taken as any extension of warranty period.
2- End of life is defined as the failure of any battery to delivery 80% of rated capacity.
Temperature compensation curve

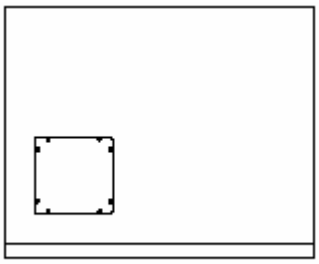
Float charge voltage:

The selection and maintenance of a specific float charge voltage is essential to achieving the designed service life and rated capacity of the battery. If the float charge voltage is too high, more float charge current will flow through the battery causing accelerated grid growth (corrosion), hence shortening the battery service life. If the float charge voltage is too low, the battery will not be maintained in a full charge state. This will cause the accumulation of the lead sulfate, resulting in degradation of capacity, followed by a reduction in service life. Battery temperatures play an important role in the selection of the float charge voltage used in any stationary application. The PRC Series batteries are designed for 10 years full float charge operation @ 77°F and 2.27 - 2.30 V.P.C. When the application's environment is such that the battery's temperature varies from the 77°F standard, changes occur in the float charge voltage requirements. These changes are due to variations in the battery self-discharge rate, internal resistance, current acceptance and electrolyte viscosity. It is therefore recommended that the float charge voltage be temperature compensated to accommodate the variations.

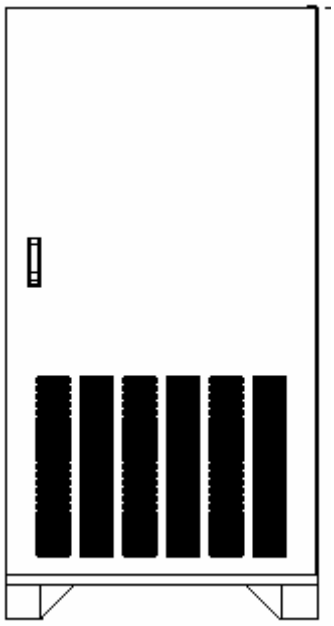
Enclosed is a copy of the "Battery Temperature vs. Float Charge Voltage" curve (DWG# BTD-177) developed for this purpose. This curve can be used in one of two ways. If the average temperature profile of the application is a known constant or is well controlled, the float charge voltage can be set on the charger according to the compensation curve. If the application calls for unknown battery temperatures or variations (ex: day / night, winter / summer, ect.), the charger design can be modified to automatically compensate for these variations. This modification is relatively simple to accomplish, as the compensation factor is linear in nature over a wide range of temperatures. Please refer to the curve DWG # BTD-177 for further details.



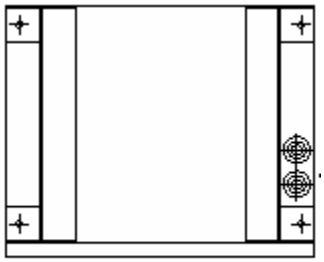
Floor Loading



TOP VIEW



FRONT VIEW



Bottom View

Location and Mounting

Mounting holes are provided on the cabinet for securing the cabinet to the floor when necessary. If a multi-cabinet system was installed, consult the inter-cabinet connection drawings, supplied with the system, for proper positioning and spacing between each cabinet. Cabinets must be bolted to the floor if UBC seismic zone and Underwriters Laboratories requirements are to be met.

Cabinets may also have levelers, casters or both. When installed one or both should have been adjusted properly by a qualified service person. Some cabinets may not have levelers, casters or both; instead a floor loading plate may have been installed for proper cabinet weight distribution.

NEUTRALIZING SPILLED ACID

Sulfuric acid: Sulfuric acid is a strong corrosive. Contact with the acid can cause severe burns to the skin and eyes. Ingestion of sulfuric acid will cause gastro intestinal tract burns.

First aid -

- Sulfuric acid: Skin contact: Flush with water for 15 minutes. Remove contaminated clothing. Call physician if contact area is large, or if blisters form.
- Eye contact: Call physician immediately, flush with water until physician arrives.
- Ingestion: Call physician DO NOT INDUCE VOMITING. DO NOT GIVE ANYTHING TO AN UNCONSCIOUS PERSON.

Spill or leak procedures: If sulfuric acid is spilled from a battery, neutralize the acid with sodium bicarbonate (baking soda), sodium carbonate (soda ash) or calcium oxide (lime). Flush the area, and dispose of as hazardous waste.

Waste disposal method:

Spent lead acid batteries are disposed of using three (3) acceptable methods: send the batteries to:

1. Licensed secondary lead smelters for recycling
2. Reputable battery handlers
3. Reputable scrap dealers.

If the user has to transport these batteries to the smelters, the user must follow department of transportation (DOT) regulations. A copy of this material safety data she et must be supplied to any scrap dealer or secondary lead smelter. Follow applicable Federal, State, and Local regulations.

Protection: Skin - rubber gloves, apron.

Respiratory: Protective equipment must be worn if the battery is cracked or otherwise damaged. HEPA respirator should be worn during reclaim operations, if the OSHAPEL is exceeded.

Eyes safety: Goggles, face shield.

Electrical safety: Due to the low internal resistance of Power Batteries and high power density, high levels of short circuit current can be developed across the battery terminals. Do not rest tools or cables on the battery. Use insulated tools only. Follow any installation instructions and diagrams when installing or maintaining battery systems.

VISUAL INSPECTION AND OPEN CIRCUIT VOLTAGE (OCV) MEASUREMENT

8.0

Battery Inspection:

A detailed visual inspection of each battery should be performed.

Items to be checked are:

1. Signs of damage to the case, cover or terminals.
2. Staining of the case, terminals or surrounding areas.
3. Excessive swelling of battery case.
4. Evidence of melting or thermal damage to the case cover and terminal post-seal.
5. The supporting cabinet, rack or tray should be checked confirming that there is no physical damage or corrosion.

Cable Connections:

Care must be taken to insure that all cables within the cabinet(s) are mechanically and electrically secure.

All connections should be retorqued annually to 5 IN-LB less than initial values specified on the battery label.

For first time battery cable installation, connections should be torqued to the stipulated value on the battery label located on the battery. In all other cases, torque cable connections to 5 IN-LB less than the labeled torque value.

The connections must be retorqued with a torque wrench. Using only a wrench will cause strain on the terminal and internal battery connections resulting in permanent battery damage.

The retorqing is necessary to insure good low resistance connections and equal battery float voltage distribution. Loose connections can result in high power drains and high terminal temperatures on discharge, resulting in reduced capacity, possible personal injury and equipment damage.

Caution: **DO NOT over-torque terminal connections**. Excessive pressure on the terminal will cause creep flow of lead, resulting in low contact pressure, loose connections, and possible permanent damage to the terminals.

SAFETY PROCEDURES AND TOOL LIST NEEDED FOR SYSTEM MAINTENANCE

9.0

Protective Equipment:

1. Goggles and face shields.
2. Acid-resistant insulated gloves.
3. Protective aprons and overshoes.
4. Lifting devices of adequate capacity, when required.
5. All tools used during battery installation and system hook-up must be insulated.
6. Use rubber mats on floor and over batteries when working on the battery system connections.

Safety Procedures:

1. Inspect all lifting equipment for functional adequacy and to make sure it is of sufficient capacity to lift the weight involved.
2. Prohibit smoking and open flame, and avoid arcing in the immediate vicinity of the battery.
3. Ensure that adequate illumination requirements for inside the battery system are met.
4. Always make sure that there is an unobstructed path from the battery area to the exit.
5. Avoid static buildup by having personnel contact ground prior to working on batteries.
6. Servicing of battery or batteries should be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.
7. When replacing batteries, use the same number and type specified on the battery or drawing. The battery or batteries should be valve-regulated lead acid type.

8. **Caution** – Do not dispose of battery or batteries in a fire. The battery may explode.

9. **Caution** – Do not open or mutilate the battery or batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.

10. **Caution –** A battery can present a risk of electrical shock and high short circuit current. Observe proper precautions.

11. Proper disposal of battery or batteries is required. Refer to your local codes for disposal requirements.

12. The following safety procedures shall be followed:

    A. Remove watches, rings, and other metal objects.

    B. Use tools with insolated handles.

    C. Where rubber gloves and boots.

    D. Do not lay tools or metal parts on top of batteries.

    E. Disconnect charging source prior to connecting or disconnecting battery terminals.

13. Determine if the battery is inadvertently grounded. If inadvertently grounded, remove source of ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shocks will be reduced if such grounds are removed during maintenance. This paragraph is applicable to a UPS and a remote battery supply not having a grounded supply circuit.

Tool List needed for System Maintenance:

1. **Digital Voltmeter:** 3-1/2 digit minimum 0.25% accuracy, rated 600 V.D.C. minimum. Due to the close tolerances needed for battery maintenance (typically 20-40 MV on a 20V scale) analog meters are not recommended. The voltmeter should be checked and calibrated at yearly intervals.

2. **Thermometer:** Thermocouple contact type, 1°F (0.5°C) accuracy. Mercury in glass thermometers can be used for ambient air temperature readings. However, a surface contact type is needed for individual battery temperatures. Infrared sensing optical thermometers may also be used for this application.

3. **Capacity Tester:** This can be an external load tester or the UPS. It is recommended that all battery systems be tested for rated capacity at least every two years or until the batteries reach 85% capacity. Annual testing should be performed thereafter, until the batteries reach 80% capacity.

4. **Microhmeter:** Biddle Instrument-DLRO or equivalent low resistance ohmmeter.

5. **Torque Wrench:** 0-120 in-lbs, 5 in-lbs graduations. The wrench and all other equipment used in battery maintenance must be insulated to prevent short circuit and calibrated every year.

6. **Other tools needed:** End wrenches (insulated), screwdrivers (insulated), socket sets (insulated), plastic handled cleaning brushes. All tools must be insulated to ensure the safety needed battery system maintenance.

Battery Installation and Operating Instructions

10.0

Applicable for CG-CSL, CSL, MC, MCG, MRV, PL, PL-C, PM, PM-F, PRC PS, SL, SLF, TC, TG, TL, TL-SLC, WC and WCG Batteries

General Information

In normal use, POWER BATTERY VRLA batteries will emit no gases. However there is the possibility that under abnormal operating conditions or as a result of damage or abuse; the batteries might release hydrogen. In order to insure the proper function of its batteries POWER BATTERY strongly recommends compliance to its operating installation and maintenance instructions.

Receiving

Upon receipt of shipment all cartons should be inspected and matched against packing list. Any shortages of batteries, cables or hardware should be immediately reported to Power Battery. Any damages upon receipt of shipment should be claimed as freight damage to the shipper. No replacement will be made unless missing or damaged items are properly noted on receiving documents before customer signature.

Storage

All batteries are shipped in a charged condition. If batteries are not installed immediately they should be stored in a cool, clean and dry area. These batteries should ideally be stored on a float charge. If not, then batteries should be recharged when open circuit voltage falls to 2.07 volts per cell, and/or every 6 months, whichever occurs first (see charging section for specifications).

Location

Before proceeding with installation, review battery system drawings and assemble according to provided instructions. Normal battery operating temperatures are between 68°F (20°C) and 77°F (25°C). Cabinet enclosed battery systems are shipped fully assembled and internally pre-wired. Internal battery connections should be retorqued annually. Install cabinet(s) in a cool, clean and dry area.

Battery Connections

When installing batteries in a system, prepare contact surface of terminals to a clean, metallic finish. Use a wire brush to clean battery terminals and a plastic bristle brush to clean cable lugs. Apply a thin coat of an approved anti-corrosive compound to all contact surfaces of battery terminals. Torque all connections to the recommended value. Apply a final thin coat of anti-corrosive compound to all metal surfaces. Charging Batteries are shipped from Power Battery at approximately 95% capacity, and will attain 100% capacity after 6 months on float charge. Batteries must be maintained on float charge and should be fully recharged within 24hrs after any discharge. A high rate charge may be used to speed up the charging process, but only after a discharge. High rate charging should last for 6-8 hrs. maximum, then all batteries should be put back on float charge. All charging must be at fixed voltage.

Recommended Charging Parameters:

- Float voltage: 2.27 - 2.30 volts/cells
- High-charge voltage: 2.31 - 2.35 volts/cells => Above 2.37 volts/cell batteries may emit hydrogen gas => Average ambient temperature: 77 °F (25°C)

Maintenance

The following minimum maintenance procedures must be followed and recorded in the Field Service Report. Insufficient records and/or failure to perform maintenance on the battery system may conditionally void the warranty.

Monthly Inspections:

1. General inspection of batteries, rack(s) or cabinet(s)
2. Check charger voltage and current operation.
3. Measure float charge voltage at battery terminals.
4. Measure charge float current.
5. Check battery environment and ambient temperatures.

Semi-Annual: (perform monthly inspection plus)

1. Spot-check individual battery temperatures.
2. Measure individual battery float voltages.

Annual: (perform semi-annual inspection plus:)

1. Detailed visual inspection of individual batteries.
2. Inspected all connections for cleanliness, corrosion, etc.
3. Measure micro OHM meter value of all terminal connections.
4. Restore all connections as required.
5. Retorque all connections to recommended values.
6. Perform general system maintenance, clean batteries, cabinet(s) or rack(s).

Bi-Annual: (perform annual inspection plus:)

1. Perform discharge test at rated capacity monitoring parameters continuously. Note: Some larger and/or custom designed battery systems may require more frequent specialized maintenance inspections. Safety tips: 1- Limit access to authorized personnel only.
2. Read all instructions and specifications prior to performing work on the batteries.
3. Do not smoke, light matches or cause sparks near any storage battery.
4. Remove rings and metal watchbands and jewelry before working on batteries.
5. Do not place tools or metal objects on battery.
6. Use insulated tools when working on battery.
7. Make sure installation is in accordance with engineering instructions prior to battery start-up.
8. Review all battery specifications from instructions.
9. Perform routine maintenance from instructions.

Field Service Report Form:

POWER
Power for a World of Applications

INSTALLATION AND OPERATING INSTRUCTIONS

FIELD SERVICE REPORT FORM

Power Battery's system model no: _____

Customer's system ID no: _____

Date of installation: _____ Inspection date: _____

Type of inspection: ☐ Monthly ☐ Semi-annual ☐ Annual ☐ Bi-annual

	System Information
- Charger model	
- Environmental conditions	
- Charge voltage at battery	
- Charge current	
- Float setting	
- Hi-rate setting	
- Physical condition	
- Retorqued	
- Full discharge test	
- Temperature of the Batteries	

Individual Battery Checks (test from positive to negative)

Battery #	Volts	Battery #	Volts	Battery #	Volts	Battery #	Volts
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

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1382-2-0203

POWER BATTERY MODEL NUMBER REFERENCE GUIDE

CURRENT MODEL #	TERM. TYPE	NEW MODEL #	TERM. TYPE	AH C/20	AH C/8	DIMENSIONS L" X W" X H"	COMMENTS
PRC1225X or TC-1225X	L	PRC12225 or TC-1225	L	24		6.5 X 6.81 X 4.94	
PRC1230X or TC-1230X	L	NONE	L				DISCONTINUED - 7/2000
PRC1235X or TC-1235X	L	PRC1235L or TC-1235L	L	32		7.1 X 5.18 X 7.19	
PRC1250XL or TC-1250XL	L	PRC1250S or TC-1250S	S	50		8.6 X 5.36 X 8.65	
PRC1265 or TC-1265	L	PRC-1265 or TC-1265S	S	63		10.2 X 6.67 X 9.44	
PRC1280X or TC-1280X	L	NONE					DISCONTINUED - 7/2000
PRC1290X or TC-1290X	L	PRC1290S or TC-1290S	S	76		10.2 X 6.67 X 9.44	
PRC12100X or TC-12100X	L	PRC12100S or TC-12100S	S	91		12.0 X 6.86 X 9.58	
PRC12110X or TC-12110X	L	NONE					DISCONTINUED - 7/2000
PRC12120X or TC-12120X	L	PRC12120S or TC-12120S	S	110		13.5 X 6.81 X 9.2	NEW CASE W/HANDLE & COVER
PRC12150X or TC-12150X	L	PRC12150C or TC-12150C	C	130		13.5 X 6.81 X 11.5	NEW CASE W/HANDLE & COVER
PRC12150S or TC-12150S	S	PRC12150C or TC-12150C	C	130		13.5 X 6.81 X 11.5	NEW CASE W/HANDLE & COVER
PRC6165X or TC-6165X	L	NONE					DISCONTINUED - 7/2000
PRC6200X or TC-6200X	L	PRC6200S or TC-6200S	S	208		10.62 X 7.38 X 11.63	
PRC6225X or TC-6225X	L	PRC6225S or TC-6225S	S	220		10.62 X 7.38 X 11.63	
SLF-12105	C	NO CHANGE	C	91		21.0 X 4.28 X 9.63	
SLF-12205	C	NO CHANGE	C	184		21.12 X 8.7 X 10.1	
MC-90X	S	MC-90	S	76		10.91 X 6.67 X 9.44	
DID NOT EXIST		MC-90P	C	76		10.23 X 6.67 X 9.04	HEAVY DUTY CASE
MC-100X	S	MC-100	S	91		12.06 X 6.68 X 9.58	
DID NOT EXIST		MC-100P	C	91		12.06 X 6.68 X 9.09	HEAVY DUTY CASE
DID NOT EXIST		MC-120	S	110		13.5 X 6.81 X 9.20	
DID NOT EXIST		MC-120P	C	110		13.5 X 6.81 X 8.45	HEAVY DUTY CASE
DID NOT EXIST		MC-150	S	130		13.5 X 6.81 X 11.5	
DID NOT EXIST		MC-150P	C	130		13.5 X 6.81 X 10.82	HEAVY DUTY CASE
DID NOT EXIST		TL-1230	C		29	7.71 X 5.18 X 7.19	
DID NOT EXIST		TL-1245	C		45	8.61 X 5.36 X 8.20	
DID NOT EXIST		TL-1270	C		68	10.23 X 6.67 X 9.04	
DID NOT EXIST		TL-1280	C		82	12.06 X 6.68 X 9.09	
DID NOT EXIST		TL-1295	C		96	13.5 X 6.81 X 8.45	
DID NOT EXIST		TL-12120	C		118	13.5 X 6.81 X 10.82	
DID NOT EXIST		TL-6195	C		193	10.7 X 7.38 X 10.93	
DID NOT EXIST		TL-2480	C		480	10.7 X 7.38 X 10.94	
CSL-1280	C	NO CHANGE	C		82	21.0 X 4.28 X 9.63	
CSL-12100	C	NO CHANGE	C		100	21.0 X 4.28 X 9.63	
CSL-12170	C	NO CHANGE	C		170	21.12 X 8.7 X 10.1	
CG-30-12SLC	SLC	TL-1230SLC	C		30	7.17 X 5.18 X 7.38	
CG-45-12SLC	SLC	TL-12445SLC	C		45	8.61 X 5.36 X 8.65	
DID NOT EXIST		TL-1280SLC	C		82	12.06 X 6.68 X 9.54	
TC-2550XC	C	TC-2550C	C		510	10.7 X 7.38 X 10.93	
TC-2600XC	C	TC-2600C	C		552	10.7 X 7.38 X 10.94	

General specifications									
Battery model number		Ratings			Dimensions - in / mm			Weight	Terminal Types
Standard	Flame Retardant	Volts	AH	* KW	L	W	H	lbs / kgs	
PRC-1225	TC-1225	12	24	0.441	6.50 / 165	6.81 / 173	4.94 / 125	21.5 / 9.75	Flag
PRC-1235L	TC-1235L	12	33	0.712	7.71 / 196	5.18 / 132	7.19 / 183	26.7 / 12.1	"L" Type
PRC-1255S	TC-1255S	12	55	1.100	9.00/ 229	5.50 / 140	9.00 / 229	37.0 / 16.8	1/4 " Stud
PRC-1265S	TC-1265S	12	63	1.107	10.2 / 259	6.67 / 169	8.85 / 225	50.7 / 16.0	1/4 " Stud
PRC-1290S	TC-1290S	12	76	1.701	10.2 / 259	6.67 / 169	8.85 / 225	60.6 / 27.5	1/4 " Stud
PRC-12100S	TC-12100S	12	91	1.909	12.0 / 305	6.68 / 170	8.85 / 225	71.9 / 32.7	1/4 " Stud
PRC-12120S	TC-12120S	12	110	2.227	13.5 / 344	6.76 / 172	9.25 / 235	81.8 / 37.2	1/4 " Stud
PRC-12150C	TC-12150C	12	130	3.030	13.5 / 344	6.76 / 172	10.87 / 276	100.1 / 45.5	1/4 " C.I.
PRC-636	-	6	36	0.295	6.25 / 159	3.35 / 85	7.00 / 178	13.0 / 5.90	0.250 " Tab
PRC-6200S	TC-6200S	6	208	1.856	10.7 / 272	7.38 / 187	11.6 / 295	77.2 / 35.1	5/16 " Stud
PRC-6225S	TC-6225S	6	220	2.058	10.7 / 272	7.38 / 187	11.6 / 295	82.2 / 37.4	5/16 " Stud
-	TC-2550C	2	510	** 1.063	10.7 / 272	7.38 / 187	10.9 / 278	81.9 / 37.2	5/16 " C.I.
-	TC-2600C	2	552	** 1.150	10.7 / 272	7.38 / 187	10.9 / 278	87.0 / 39.6	5/16 " C.I.
Front Access									
-	SLF-12105	12	91	1.909	21.0 / 534	4.28 / 109	9.63 / 245	74.0 / 33.6	1/4 " C.I.
-	SLF-12205	12	184	3.946	21.1 / 536	8.46 / 215	10.1 / 256	152 / 69.0	5/16 " C.I.
-	SLF-12250	12	220	5.030	21.1 / 536	8.46 / 215	10.1 / 256	162 / 73.4	5/16 " C.I.

* 15 minutes to 10.02 volts (1.67 volts per cell). ** 30 minutes to 10.02 volts (1.67 volts per cell).

General Specifications Continued

Battery model number	Rating			Dmensions - in / mm			Weight
Standard / Flame returdant	Volts	AH	KW	L	W	H	lbs / kgs
PRC/TC-1225	12	24	0.441	6.50 / 165	6.81 / 173	4.94 / 125	21.5 / 9.75
PRC/TC-1235L	12	33	0.712	7.71 / 196	5.18 / 132	7.19 / 183	26.7 / 12.1
PRC/TC-1255S	12	55	1.100	9.00 / 229	5.50 / 140	9.00 / 229	37.0 / 16.8
PRC/TC-1265S	12	63	1.107	10.2 / 259	6.67 / 169	8.85 / 225.	50.7 / 16.0
PRC/TC-1290S	12	76	1.701	10.2 / 259	6.67 / 169	8.85 / 225.	60.6 / 27.5
PRC/TC-12100S	12	91	1.909	12.0 / 305	6.68 / 170	8.85 / 225.	71.9 / 32.7
PRC/TC-12120S	12	110	2.227	13.5 / 344	6.76 / 172	9.25 / 235	81.8 / 37.2
PRC/TC-12140C	12	118	2.850	13.5 / 344	6.76 / 172	10.87 / 276	100.1 / 45.5
PRC/TC-12150C	12	130	3.030	13.5 / 344	6.76 / 172	10.87 / 276	100.1 / 45.5
PRC-636	6	36	0.295	6.25 / 159	3.35 / 85	7.00 / 178	13.0 / 5.90
PRC/TC-6200S	6	208	1.856	10.7 / 272	7.38 / 187	11.6 / 295	77.2 / 35.1
PRC/TC-6225S	6	220	2.058	10.7 / 272	7.38 / 187	11.6 / 295	82.2 / 37.4
TC-2550C	2	510	1.063	10.7 / 272	7.38 / 187	10.9 / 278	81.9 / 37.2
TC-2600C	2	552	1.150	10.7 / 272	7.38 / 187	10.9 / 278	87.0 / 39.6
SLF-12105	12	91	1.909	21.0 / 534	4.28 / 109	9.63 / 245	74.0 / 33.6
SLF-12120	12	110	2.310	21.0 / 534	4.28 / 109	9.63 / 245	78 / 35.4
SLF-12205	12	184	3.946	21.1 / 536	8.46 / 215	10.1 / 256	146.5 / 66.5
SLF-12250	12	220	5.030	21.1 / 536	8.46 / 215	10.1 / 256	150 / 67.9

HIGH-RATE SERIES-WATT CONSTANT CURRENT DISCHARGE RATES @ 77º F (25º C)

Battery		Final	Watts per battery @ 77º F (25º C) – minutes/hours											
Model	Volts	V.P.C.	5	10	15	20	30	60	90	2	4	6	8	12
PRC/TC 1225	12	1.67	691	525	425	358	275	169	-	-	-	-	-	-
		1.75	627	478	403	345	266	166	122	97	55	39	31	22
		1.8	578	455	376	322	254	160	119	95	53	38	30	21
PRC/TC 1235L	12	1.67	1612	1038	785	634	467	275	-	-	-	-	-	-
		1.75	1417	956	735	596	440	260	199	165	95	68	53	37
		1.8	1320	918	713	582	433	257	188	151	88	63	49	34
PRC/TC 1255S	12	1.67	2327	1549	1236	1020	750	440	-	-	-	-	-	-
		1.75	1920	1448	1153	963	723	428	314	253	148	107	84	57
		1.8	1800	1352	1093	928	596	423	309	248	145	103	80	55
PRC/TC 1265S	12	1.67	1850	1360	1107	922	719	443	-	-	-	-	-	-
		1.75	1708	1280	1050	890	680	434	319	255	148	105	83	60
		1.8	1567	1200	970	820	640	410	309	247	141	102	80	59
PRC/TC 1290S	12	1.67	3049	2292	1800	1464	1074	630	-	-	-	-	-	-
		1.75	2711	2045	1630	1360	1022	565	456	365	209	152	118	81
		1.8	2542	1911	1543	1311	1005	559	408	329	191	136	106	73
PRC/TC 12100S	12	1.67	3517	2640	2100	1740	1302	732	-	-	-	-	-	-
		1.75	3223	2431	1937	1617	1215	719	526	442	255	184	143	98
		1.8	3023	2272	1834	1558	1194	710	518	418	243	174	135	93
PRC/TC 12120S	12	1.67	4210	3035	2400	1950	1436	847	-	-	-	-	-	-
		1.75	3931	2836	2260	1887	1417	838	614	506	292	210	163	112
		1.8	3686	2650	2140	1818	1393	829	605	488	284	202	157	108
PRC/TC 12140C	***12***	***1.67***	***4818***	***3630***	***2850***	***2292***	***1685***	***984***	***712***	***-***	***-***	***-***	***-***	***-***
New		***1.75***	***4499***	***3391***	***2729***	***2235***	***1664***	***975***	***706***	***-***	***-***	***-***	***-***	***-***
		1.8	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***	***-***
PRC/TC 12150C	12	1.67	5480	3900	3030	2520	1830	1128	-	-	-	-	-	-
		1.75	5117	3643	2902	2458	1807	1117	771	650	368	253	204	136
		1.8	4600	3405	2748	2368	1775	1108	761	583	339	242	187	129
PRC/TC 6200S	6	1.67	3019	2292	1856	1562	1203	740	-	-	-	-	-	-
		1.75	2746	2071	1759	1506	1164	724	532	424	241	172	135	97
		1.8	2527	1990	1645	1407	1112	700	518	414	233	166	131	93
PRC/TC 6225S	6	1.67	3348	2542	2058	1691	1271	782	-	-	-	-	-	-
		1.75	3041	2318	1951	1631	1229	765	562	448	255	182	143	102
		1.8	2802	2207	1824	1523	1174	739	547	437	246	175	138	98
TC-2550C	2	1.67	–	–	–	–	1063	665	-	-	-	-	-	-
		1.75	–	–	–	–	1017	647	462	356	192	134	104	72
		1.8	–	–	–	–	–	616	436	340	185	129	100	70
TC-2600C	2	1.67	–	–	–	–	1150	720	-	-	-	-	-	-
		1.75	–	–	–	–	1100	700	500	385	208	145	112	78
		1.8	–	–	–	–	–	666	471	368	200	140	108	76
SLF-12105	12	1.67	3257	2454	1909	1564	1161	685	-	-	-	-	-	-
		1.75	3041	2293	1827	1525	1146	678	496	409	236	170	132	91
		1.8	2852	2143	1730	1470	1126	670	489	394	229	164	127	88
SLF-12120	***12***	***1.67***	***3319***	***2520***	***2040***	***1719***	***1324***	***814***	***596***	***-***	***-***	***-***	***-***	***-***
New		***1.75***	***3016***	***2356***	***1934***	***1656***	***1280***	***796***	***585***	***466***	***334***	***265***	***149***	***96***
		1.8	***2779***	***2187***	***1808***	***1547***	***1221***	***769***	***569***	***454***	***325***	***256***	***144***	***93***
SLF-12205	12	1.67	***6953***	***5021***	***3946***	***3194***	***2370***	***1384***	***-***	***-***	***-***	***-***	***-***	***-***
		1.75	***6281***	***4654***	***3714***	***3075***	***2321***	***1368***	***1019***	**838**	**477**	**349**	**272**	**187**
		1.8	**5704**	**4331**	**3471**	**2921**	**2230**	**1340**	**996**	**801**	**460**	**328**	**256**	**175**
SLF-12250	12	1.67	7950	6280	5030	4085	3070	1740	-	-	-	-	-	-
		1.75	7490	6040	4730	3867	2860	1700	1286	1029	559	398	319	-
		1.8	6800	5290	4300	3690	2700	1640	1211	970	536	379	301	-

- * 15 minutes to 10.02 volts (1.67 volts per cell).
- ** 30 minutes to 10.02 volts (1.67 volts per cell).
- For extended discharge rates on any one battery, please click below on the battery model number
- * 15 minutes to 10.02 volts (1.67 volts per cell).
- ** 30 minutes to 10.02 volts (1.67 volts per cell).
- For extended discharge rates on any one battery, please click below on the battery model number
- Obsolete models - PRC/TC-1230X, PRC/TC-1280X, PRC/TC-12110X, PRC/TC-6165X
- Specifications are subject to change.

No transport restrictions Surface transport

- Classified as non-hazardous material as relates to DOT-CFR Title 49 part 171-189
- Marine transport. Classified as non-hazardous material as per IMDG amendment 27
- Air transport. Complies with IATA / ICAO, special provision A67.

No transport restrictions

- Surface transport. Classified as non-hazardous material as relates to DOT-CFR Title 49 part 171-189.
- Marine transport. Classified as non-hazardous material as per IMDG amendment 27.
- Air transport. Complies with IATA / ICAO, special provision A67.

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- To request literature from Power Battery, you can use our online literature request form.